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Hydroxyl-rich topaz in high-pressure and ultrahigh-pressure kyanite quartzites, with retrograde woodhouseite, from the Sulu terrane, eastern China

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ABSTRACT

Hydroxyl-rich topaz was recognized in thick kyanite quartzites from both high-pressure (HP) and ultrahigh-pressure (UHP) belts of the Sulu terrane, China. These quartzites contain variable proportions of quartz, kyanite, and topaz, with minor phengite, pyrite, and rutile. Some topaz grains from the UHP belt contain abundant inclusions of oriented kyanite, whereas those from the HP belt are partially replaced by woodhouseite [$CaAl_3(PO_4)(SO_4)(OH)_6$]. Most topaz crystals contain 9.5 to 13.5 wt% F [0.92–1.30 atoms per formula unit (apfu)], indicating 35–55% substitution of F by OH. Such naturally occurring, hydroxyl-rich topaz has not been previously reported. Some topaz grains from the HP belt show distinct zoning: (1) decreasing F content from narrow cores (13.3–16.5 wt%) to thick rims (9.5 wt%) or (2) oscillatory zoning (9.44–12.77 wt%). Unit-cell parameters of topaz show a positive linear correlation between the OH content and *a* and *b* as well as volume. Based on our petrologic data, the experimentally determined curve of Ky + H_2O = topaz-OH at very high pressures, and calculated OH/(OH + F) isopleths of topaz at low pressures, the topaz with $X_{OH} \sim 0.35$ from the UHP belt may have formed at *P-T* conditions within the coesite stability field. The *P-T* condition of HP topaz is less well constrained; its high X_{OH} (0.40–0.55) may have been caused by lower metamorphic temperatures and higher initial X_{OH} in comparison with UHP topaz. Hydroxyl-rich topaz together with other hydrous minerals in UHP rocks may be important carriers of H_2O to mantle depths of 100–200 km during continental subduction.